EUROPEAN METHODS FOR THE UTILIZATION OF POTATO STARCH FACTORY WASTES

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INTRODUCTION

In the course of a survey made in the summer of 1947 to determine European practices for the industrial utilization of white potatoes, some information was obtained on methods of utilizing the waste pulp and protein water from white potato starch factories.

Although no experiments have been made at this laboratory to determine the feasibility of the methods mentioned here, the information is nevertheless presented at this time because of current surpluses of white potatoes and the fact that the problem of waste disposal has already become serious in Maine potato starch-producing areas. It is hoped that the ideas presented may serve as a basis for study of this problem. They will be given consideration in the work at this Laboratory.

NATURE OF WASTES

The fluid wastes from a potato starch factory consist of a large amount of water containing dissolved proteins and sugars and small

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amounts of suspended starch and fiber. In Europe the potatoes used for starch manufacture contain, on the wet basis, about 18-½ per cent starch and from 2 to 2.5 per cent protein. About 0.13 pound of protein per pound of starch produced is lost in the watery wastes of a starch plant. This protein is in such low concentration in the combined effluents from a starch plant that its recovery would be quite out of the question.

It would have to be recovered at the steps in the process where it is most concentrated, for example, in the effluent from the protein water separator.

The potato pulp, with a moisture content of approximately 96 per cent is separated during the screening operations. The pulp can be diverted from the screens, and pressed and dried to make a feed supplement by the methods described here.

Recovery and Utilization of Wastes

What is perhaps the cheapest way to eliminate stream contamination and at the same time utilize part of the fluid factory wastes is to spray them on the fields after the potatoes have been harvested. Obviously this procedure would not be practical in hilly country. However, it is used with considerable success in Holland.

A 6-inch header is run from the factory into a field, and the effluents are pumped into this header at a pressure of 250 pounds per square inch. The header is provided with plugs so that branch headers with six outlets each can be attached successively at different points. These outlets are hose nozzles set at about 45° and arranged to rotate or oscillate. The effluent is sprayed on the area until the water on the ground is about 1 inch deep, and is then discharged on another area. For example, if three nozzles, each covering an area of 3,600 square meters, spray a total of 70 cubic meters of effluent in one hour, the total depth on 10,000 square meters (1 hectare) would be about 0.7 centimeter. Such an arrangement would thus have to be shifted about once every three hours to cover the ground to a depth of one inch. This does not allow for any absorption by the soil. Hence, the interval would actually be in excess of three hours. Likewise, a heater with six nozzles handling the same amount of effluent (70 cubic meters per hour) and covering double the area, would have to be shifted about once every six hours.

The spraying is done after the harvest, and the following spring, potatoes are planted on the sprayed field. Attempts to flood the fields without using spray has resulted in unequal distribution of the fertilizing elements and is not considered practicable. After the water has filtered

through about 2 feet of soil it is pure enough not to cause serious contamination of the canals.

Protein Recovery

Protein is not generally recovered in France or Holland. In Germany, however, where attempts were made to achieve a self-sufficient economy, this problem has been extensively studied.

The European practice, especially in Germany, is to remove the protein water from the freshly ground potatoes by diluting the slurry and passing it through either a Jahn or Uhland continuous centrifugal prior to removal of the pulp by screening. In the United States this is sometimes done, but more frequently removal of the pulp precedes removal of protein water. In either case, the effluent coming from the protein water, centrifugal separator generally contains about 1 per cent dissolved solids, about one-half of which is protein. The potato itself contains from 2.2 to 2.5 per cent protein. The low protein concentration in the centrifugal effluent results from diluting the ground potato with from 4 to 5 times its weight of water, which is necessary to achieve good protein removal. The various methods of protein recovery described here apply to these centrifugal effluents. It has been reported, however, that the Jahn Company has developed an improved centrifugal which would remove protein effectively without such high dilution of the slurry. Effluents with a protein content of approximately 2.8 per cent have been reported, but this seems questionable, as it would indicate the use of much less than an equal volume of dilution water per volume of ground potato.

One method reported to have been used on a commercial scale is to evaporate the protein water under vacuum at 45°C. to a concentration of about 48 per cent solids, that is, 35° Baumé. Forced circulation, single-effect evaporators are used. The liquid concentrate becomes extremely thick when cold. It is therefore discharged hot from the evaporator and mixed with dewatered potato pulp and then dried for feed. Büttner scraper-type dryers of the design employed for drying starch handle this product satisfactorily.

A procedure for recovering part of the protein to produce a product suitable for the enrichment of soups consists in carrying the vacuum evaporation only to between 15 and 18° Baumé. The concentrate is then removed from the evaporator and heated to 80°C. for approximately one hour. This causes the higher molecular weight proteins to precipitate. This precipitate is reported to be easily filterable in an ordinary plate and frame filter press. The dried product contains 75-80 per cent protein. About half the protein in the concentrate from the evaporator remains

in solution. The filtrate is therefore returned to the evaporator and mixed with incoming protein water.

Other experimenters found that the precipitate obtained by this procedure was difficult to filter and had to be recovered with a solid bowl centrifugal. In this case the product was mixed with pressed pulp and dried for feed. The feed had the following analysis on a moisture-free basis: 20 per cent protein, 45 per cent starch, and 35 per cent fiber.

Methods based on precipitation of the protein recover only approximately 50 per cent of it. A method which recovers all of it consists in evaporating the protein water under vacuum at a temperature of less than 45°C. in order to avoid precipitation and carrying the evaporation to nearly 65 per cent solids. It is then spray-dried. The product is a dark-brown powder with a salty, agreeable flavor and has been reported to contain about 45 per cent protein. It has found some use in soups.

It is questionable whether any of these methods would prove profitable as a source of protein, but one or more of them might be justified on the basis of reducing stream contamination.

Pulp Recovery

In small potato starch factories the wet pulp is frequently accumulated in pits, from which it is hauled to local farms for hog feed. In the larger plants in Germany, Holland and France, however, the pulp is dewatered (with or without liming), usually in roller presses of the Büttner type, and is then dried. Drying can be done in steam tube dryers; in Büttner scraper-type dryers of the type used for starch; in direct heat, parallel-flow, high-temperature dryers; and in blast-type flash dryers. From 2 to 6 per cent of the original weight of the potato is obtained as pulp. The product usually contains about 6 per cent protein and 40 per cent starch on a moisture-free basis. It is used for cattle feed either by itself or mixed with recovered protein.

There seems little question but that pressing and drying pulp would be a desirable operation in our starch plants. The process is simple, and the value of the product as a feed should exceed the cost of preparing it. Information on processing potato pulp for feed may be found in AIC-204, "Recovery and Utilization of Pulp from White Potato Starch Factories." This was recently published by the Bureau of Agricultural and Industrial Chemistry and may be obtained from the Eastern Regional Research Laboratory, Philadelphia 18, Pennsylvania.